Assessment of CREP Wetland Habitat Quality for Wildlife

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Abstract

The Conservation Reserve Enhancement Program (CREP) in Illinois began in May 1998 with restoration and creation of wetland areas within the Illinois River watershed. Validating scientific research is now needed to estimate the habitat quality and wildlife usage of CREP sites. These data are essential to enhance the effectiveness of CREP and for managers to evaluate the efficiency of new practices to successfully restore wetland communities in Illinois. Biological surveys were conducted on 92 sites to assess their wildlife value using a wildlife-suitability index, a floristic quality index, and a hydrophyte index. This survey information plus digital habitat cover data were used to assess the quality and potential of these restoration sites as habitat for threatened, endangered and migratory vertebrate species. Potential created habitat for specific wetland species ranged from zero to more than 2000 acres at surveyed sites. All three indices showed a significant improvement with increased site size but not over time. The development of CREP sites into wetland communities appears to be slowed by human impacts, drainage, and nuisance plants.

Introduction

The continental United States has lost 115.5 million acres of wetlands since European settlement (Dahl 2000). Currently the annual net loss of wetlands is estimated at 58,500 acres. In Illinois, wetlands once covered 23 % of the land or 8 million acres (Havera 1985). By 1985, 90% of those wetlands had been destroyed.

CREP is creating and restoring wetlands that were previously converted to farmland. Approximately 130,000 acres have been restored in Illinois as of the beginning of this study. The United States Department of Agriculture (USDA) has committed over

3 billion dollars in state contracts over the next 15 years (FSA 1), with 260 million dollars contracted to Illinois alone. The goals of Illinois CREP are to reduce sedimentation, as well as phosphorous and nitrogen loading, and increase populations of waterfowl, shorebirds and state and federally listed species. Since 1998, Illinois CREP has created significant acreage of restored and protected habitat for the potential use by these species. In Illinois, 82 percent of all vertebrates and 18 percent of plants are wetland species making every created wetland acre vital.

These newly restored acres of habitat are essential for many species that rely on mixed grasslands for habitat. Cunningham (2000) found that CRP fields provided more habitat and supported greater densities of certain true grassland birds than did public lands. These idle CRP grasslands have been shown to yield high nest success in upland nesting ducks (Duebbert and Kantrud 1974, Klett et al. 1988, Luttschwager et al. 1994 and Greenwood et al. 1995). Reynolds et al. (2001) found that duck nest success is directly related to the amount of planted CRP grasslands. This habitat also provides valuable habitat for prairie birds, game birds and many resident mammals (Duebbert and Lokemoen 1976, DeVault et al. 2002, Haegen et al. 1999), spreading predators out and reducing the percentage of nests that become predated.

Little or no research has been done in Illinois to estimate the quality and quantity of habitat created by Illinois CREP or its use by resident and migratory wildlife. Thus, no baseline data exist to establish the use of these newly protected wetlands or to evaluate the effectiveness of the CREP program in Illinois. Without evaluations of the plants, wildlife, and the quality of habitat, the benefits of a long-term program like CREP cannot be truly estimated.

A habitat-based approach, utilizing information on the quality of the plant community was used to directly measure community habitat and indirectly measure wildlife usage of Illinois CREP sites. Specifically, a wildlife-scoring matrix similar to Balzano et al. (2002) was used to evaluate CREP wetland projects. The wildlife-scoring matrix provides an estimate of the value of the CREP sites as potential habitat for wildlife. This score uses a combination of plant, soil, adjacent resources, and community structure to relate site quality to wildlife value. The matrix score was supported with data from a floristic quality index (FQI) of the CREP sites following methods of Taft et al. (1997) and a second FQI for hydrophytic plants based on the Indiana Wetland Rapid Assessment Protocol (Squiers et al. 2000). These FQI's provided information on the dependence of species of natural areas, behavior and pattern of occurrence, their tolerance to disturbance and quality of wetland plants species in CREP sites. This helps to reflect concerns in the creation of wetlands and wetland function in comparison to other wetlands in Illinois based on similar application of the FQI.

Characteristics based on detailed information from site visits, the major plant communities and land formations were used to digitize plant coverage and land changes using recent (1998-1999) Digital Orthophotographic Quadrangles as a base data layer. Specific site information such as wetland area, and zonation was digitized creating maps to show current 2003 site conditions and to provide a baseline for future sampling visits to sites. All sites were analyzed for specific vegetation and hydrologic habitat components and then compared to Illinois GAP vertebrate distribution data. This gave an estimate of the potential CREP habitat created for threatened and endangered species, and various other migratory wetland species.

Study Area

Sites were selected from the Illinois Conservation Tracking System that is currently mapping and recording all the CRP and CREP sites in Illinois. These sites were then sorted to contain sites designed to be wetlands, or water containing sites within Illinois River watershed (Fig 1.1) and part of the CREP program. This reduced the possible number of sites from 5969 to 1213. A random number generator was used to select 150 sites from that modified database. The final set of sites included 25 in Knox, 33 in Fulton, 73 in Schuyler, 3 in Sangamon, and 16 in Christian county. Of those sites, only 92 were sampled due to project time constraints and access problems such as obtaining permission to cross or survey on private property.

Methods

Sites were sampled between 15 June 2003 and 15 August 2003. Transect lines were marked at 50 m intervals starting from site boundary and perpendicular to hydric features such that transects crossed vegetation zones created by the presence of water. These intervals were utilized to standardize the sampling intensity per unit area for both large and small sites. A final transect line was established perpendicular to the first transect lines and near the center of the CREP wetland site. Flooding, soil saturation, wetland drainage patterns, and high water marks were recorded along each transect line (Segal et al. 1987, Tiner 1999). Soil cores were analyzed for hydric soil formation at regular 50-meter intervals along transects. All plants species growing within 3 meters of the transect line were recorded. Erosion and land slope were recorded for each site.

Specific plots were sampled at 50m intervals along each of the transect lines. Water was recorded as less than 15 cm, 15 to 24 cm or greater than 25 cm (Fredrickson and Reid 1980, Kroll et al., 1997). If water was not present, hydrologic indicators were recorded (Segal et al., 1987, Tiner 1999). Soil core samples were compared to Munsell color charts and examined for hydration depth, presence of hydrogen sulfide gas, muck or peat layer, chroma color of 2 or less, dominant color of 1 or less and ferrous iron test (Mitsch and Gosselink 2000).

Land slope was recorded either as none, slight or steep and erosion indicators were recorded. Vegetation was sampled taking care to not destroy private CREP wetland sites and existing vegetation. Foliage density was recorded as aerial coverage (Table 1.1) (Daubenmire 1968) or the percent each stratum shades the ground from above. All dominant cover types were recorded as percent aerial coverage according to Daubenmire (1968).

A wildlife-scoring matrix was used to rate the potential for habitat use. The wildlife-scoring matrix groups indices into categories reflecting wetland characteristics and function, and suitability for migratory and resident wetland birds (Table 2.2). This matrix was simplified to accommodate the limited time available per site due to the total number of sites that were required to be sampled and the project deadline. Sub-categories within each of the main categories were rated 1, 2, or 3 for their quality, 3 being the highest quality (Table 2.3). All numbers were summed within each category. These sums were then multiplied by weighting factors (Balzano et al. 2002) for each category (Table 2.4) then all weighted scores were summed and divided by the weighting scores giving the suitability score for each site (Balzano et al. 2002) (Table 2.5). The entire wildlife-scoring matrix is given as Table 2.6.

All plant species were given a coefficient of conservatism value (C) (0 to 10); based on the plant's tolerance to disturbance, need of habitat integrity, pattern of occurrence and remnant status (Taft et al. 1997). Because the initial sample set was to consist of only wetlands, a hydrophyte C (Squiers et al. 2000) was also used to rate all plant species to evaluate each site for hydrophytic vegetation. A mean C and FQI's were determined for each wetland site using both FQI (Taft et al. 1997) and the hydrophyte index (Table 3.7)(Squiers et al. 2000). An average less than 20 was scored a one because it did not function as a wetland (Swink and Wilhelm 1994). A rating of two was given to any site rated between 20 and 35, or minimal function and health. A three was given for all CREP wetland sites rating greater than 35 (Swink and Wilhelm 1994), meaning they are functional and healthy.

CREP wetland sites were evaluated and scored a 1, 2, or 3. A one represented CREP wetland sites 'with little or no resources for migratory and resident wetland birds'. Two represented CREP wetland sites 'with a limited potential for migratory and resident wetland birds'. Three represented all CREP wetland sites 'with a high potential for use by migratory and resident wetland birds'.

Detailed land-cover images were created for each CREP wetland site using Digital Orthophotographic Quadrangles (DOQ's, scale 1:24,000). Site specific data from CREP site visits were digitized onto the DOQ's using information on plant communities, plant zonation caused by hydrology, land cover data, water coverage, and land formations (bare land, open water, ditches, dirt roads and any other distinguishing features). Other information was recorded including important habitats, size and location of the nearest water source, buffer area habitat, and vegetational zones.

Surveys were not conducted to measure actual vertebrate species usage, although many species were noted during vegetational surveys. Illinois GAP (Chapa and Tweddle 2002) vertebrate distribution mapping data for threatened and endangered species and many resident and migratory birds was overlaid onto all site maps. CREP wetland sites were compared to the GAP vertebrate data. Areas where the GAP and CREP wetland sites overlapped, species habitat were weighed against the newly created CREP wetland habitat from survey data. Area data was generated from ArcGIS ® shape files labeled by specific created habitat. These habitat acres were used to estimate the amount of the potential of CREP to supply critical habitat for each of these species.

Due to the relative small sample size and the likelihood that the data do not fit a normal distribution, Spearman’s rank correlation (Conover 1971) was used to measure the degree of association and look for data trends. This was used to compare both FQI’s and matrix scores to contract year and aerial extent of the restoration. Acreage to contract year was also compared. Scatter plots were used to help define correlations and to give a visual representation of significant results. All statistical analysis was done using Statsdirect ® software.

Results

A total of 2397 acres of CREP lands was sampled on 92 separate CREP wetland sites from five different enrollment years (Table 4.8). Mixed prairie comprised the largest habitat component with 1976 acres (Figure 4.2). Forty-one percent (981 acres) of the area sampled from the 92 sites was wetlands or open water habitat. Most sites were small with 37% of the sites sampled under 10 acres and only 28% of the sites greater than 30 acres. A majority of sites or 76%, contained areas that delineated as wetlands, and

37% of all sites were dominated by noxious forbs including Common Reed (*Phragmites spp*), Reed Canarygrass (*Phalaris spp*), Giant Ragweed (*Ambrosia trifida*), Common Ragweed (*Ambrosia artemisiifolia*), Horseweed (*Conyza canadensis*), Cocklebur (*Xanthium strumarium*), Pigweed (*Amaranthus spp*), and Lambsquarters (*Chenopodium album*) (Tables 5.10 – 5.15). Extrapolated estimates for the entire Illinois CREP program were also calculated from 2003 sample data (Figure 4.3). Table 4.3 is an estimation of habitat occurrence and should only be used as a guideline of the possible distribution of habitat types in the Illinois CREP program.

CREP sites were generally associated with other wetlands with only 32% of all sites being isolated from all other wetlands. Human impact on all sites was considerable; 80% of sites were adjacent to row crop or pasture, 34% of sites were located adjacent to roadways or industrial complexes, and 29% of all sites were adjacent to at least two of these sources of human disturbance.

The wildlife-suitability matrix showed little range of variability, with no site approaching the top score of three. The wildlife-suitability matrix score did not differ significantly between contract years. Components of the matrix ranged from the lowest average for hydrology to highs in vegetation and overall site characteristics. The matrix showed a significant relationship between area class and quality where increased area strongly correlated to increased quality of site ($Rho_{91} = 0.46$, $P \leq 0.001$)(Figure 3). The Illinois FQI and the hydrophyte FQI ratings were low for all CREP wetland sites with a 22.74 and 20.01 average, respectively. The hydrophyte mean C was found to have a positive correlation with increased restoration area ($Rho_{91} = 0.26$, $P = 0.001$); hydrophyte and FQI mean C was not significantly correlated with contract year. FQI and hydrophyte indexes did not vary significantly between contract years. Both the FQI and hydrophyte indexes had a significant positive correlation with acreage with larger sites being of higher quality ($Rho_{91} = 0.24$, $P = 0.02$ and $Rho_{91} = 0.34$, $P \leq 0.001$ respectively)(Figure 4). Acreage was found to be significant between contract years with significantly larger sites contracted in 2000, and 2001 ($Rho_{91} = 0.21$, $P = 0.02$) (Figure 5), and larger average site size with an average of 35 and 42 acres, respectively.

Created potential habitat for Illinois native resident and migratory species was identified using the Illinois GAP vertebrate distribution-mapping database. Acreage analyzed was acres from CREP sites that were actually sampled and mapped. No estimate was made for the approximate 5000 remaining sites not sampled throughout the Illinois River basin. Acreage ranged from 0 acres to more than 2000 CREP created acres for many prairie species. Endangered and threatened species showed potential created habitat, from a low of 18 acres for Bobcat (*Lynx rufus*) to over 2500 acres for Northern Harrier (*Circus cyaneus*) (Table 6.16). For the American Bittern and Bald Eagle, 160 acres of potential habitat were created and approximately 20 acres could be considered as suitable for the Black-crowned Night-Heron and Least Bittern. Migratory waterfowl could benefit from the CREP sites studied, with approximately 100 acres of suitable habitat developed for Canvasback, and almost 1000 acres for the American Wigeon and Canada Goose. Species that inhabit open grasslands or shrubby areas like the Bobolink and Dickcissel gained 1976.41 acres and the Clay-colored Sparrow gained 2381.43 acres of potential habitat. Vertebrate analysis for non-listed species showed similar trends with greater potential habitat being created for species preferring open-type or grassland habitats (Table 6.17)

The relative plant species density was calculated from aerial coverage. Farm weeds tend to be most prevalent for the first two years. Other plant species became dominant as sites had time to naturalize for a few years (Tables 5.10 – 5.15). Many sites were dominated by aggressive species like giant ragweed and *Phalaris spp*.

Discussion

Community development of CREP sites from original plantings and natural regeneration appears to be becoming more complex and diverse. The majority of sites had plant communities that consisted of prairie or mixed prairie and forbs species. This is not surprising with the typical seed mixes available for the CREP program containing mainly grass and prairie species.

CREP wetland sites had slow development of hydric soils but showed development of hydrophytic vegetation. This fact in itself is not surprising as Craft et al. (2002) found soils could take 70 to more than 200 years to develop in created wetlands. The main concern focuses on tilling, mowing, the intact drainage devices, ditches, and berms separating sites from creeks and rivers. Ditching was generally designed to drain areas as rapidly as possible and quickly lowers wetland water levels (Mitsch and Gosselink 2000). Assisted drainage of sites leads to drier sites with slowed or blocked development of the wetland community. Sites were often adjacent to human disturbed areas (e.g. roads, industry, agriculture.), which Lopez and Fennessy (2002) found could lower FQI's. This is compounded by the dominance of noxious forbs that lowers site FQI's. These forbs might have been promoted by the storm water runoff from human disturbed areas, which Balzano et al. (2002) found to encourage dominance of nuisance and invasive species.

Sixty-three percent of the sites sampled were immediately adjacent to other wetlands. Mushet et al. (2002) found sites near established wetlands had increased diversity and quality of species, leading to higher FQI's. Balzano et al. (2002) found that redirecting stream flow resulted in higher wildlife scores. Illinois CREP sites might benefit from the extra flow of water from redirection of streams to help create more complex wetland communities.

With only 28% of the sites surveyed greater than 30 acres and 37% of sites less than 10 acres, CREP managers should consider the greater value on larger sites and possibly manage the CREP program to emphasize creation of larger sites to increase the program's effectiveness. The wildlife suitability index indicates site size greater than 30 acres led to improved quality. Likewise, Mathews (2003) found that species number increased with area, and Francis and Austen (2000) found species richness and FQI increased substantially with size. Balzano et al. (2002) also found that increasing wetland size lead to an increase in all indicators studied. More research is needed on the role size, shape of the site and distance from other wetland sources has on the quality for the restored site, and if smaller sites provide specialized habitat not available in larger areas. The research indicates that plant species richness and FQI scores are strongly affected by site size, and the develop into higher quality wildlife communities.

CREP wetland site FQI's did not improve in quality with age as Swink and Wilhelm (1994) and Mushet et al. (2002) found. This is possibly due to the older sites being significantly smaller than the more recently created sites skewing results by the area effect of the newer sites. There was also a small sample size in the older class of sites. The CREP sites have only been restored five or six years ago; improvements in quality may develop given more time.

Potential habitat for threatened and endangered species was created in this study but high quality communities are slow in developing at the CREP wetland sites. In a similar study of recreated wetlands, Balzano et al. (2002) also found no increase in quality over the period of their study. Langis et al. (1991) found created marshes lagged behind natural wetlands in primary production, nutrient flows, and food chain support. Craft et al. (1988) found even after 15 years CREP wetland sites remained inferior to natural sites in many characteristics and take 70 to more than 200 years to fully develop (Craft et al. 2002). Conversely, Stevens et al. (2003) found more waterfowl pairs and broods (Gadwall, American Black Duck, Green-winged Teal, and Ring-necked Duck) on restored wetlands than on reference wetlands. This increase in waterfowl use may be due to design of created sites specifically for waterfowl (Cole 1983). Considerable improvements were made on Illinois CREP sites for wildlife, with their conversion from farmland, but more is needed.

Nest success of 15.2 % is needed to maintain mallard populations (Cowardin et al. 1985), 15 % to maintain pintail population, and 20 % to maintain other upland duck species (Klett et al. 1988). Luttschwager et al. (1994) found that CRP lands left idle had the highest densities of nesting ducks and a success rate of 36 % for mallards and 33 % for blue-winged teal. Greenwood et al. (1995) also found that nest success was increased in idle grasslands, and Klett et al. (1988) found that perennial CRP was over 100-times more attractive than cropland, four-times more than hayland and 10-times more than pastureland for upland ducks. Duebbert and Lokemoen (1976) found the Cropland

Adjustment Program (CAP) plantings of cool-season grasses and legumes left idle for ten years provided attractive and secure nesting cover for dabbling ducks resulting in very high nest success. Duebbert and Kantrud (1974) also found CAP highly productive for upland nesting ducks with 6 times as many ducks as usual nesting cover. Cowardin et al. (1985) found a high percentage of mallard nests in grasslands and Reynolds (2001) found that nest success was directly related to the percent of CRP grass cover in the area and was at least partially responsible for the increase in nest success between pre-CRP and CRP periods. This research points toward the success of the USDA farmland reserve programs and the positive effect that idle grasslands can have on bird populations. The use of the combination of planting grasses and legumes and leaving the land idle provides valuable habitat for ducks and excellent production habitat for game birds (Duebbert and Lokemoen 1976). CRP-type planting on a large scale was found to increase nesting and foraging, protection for land movement and reduced predator contact (Reynolds 2001), and resulted in increased nest success in all cover types after CRP vegetation was established in the area.

The CREP program has created habitat with the potential of providing critical acreage for many Illinois species including many threatened and endangered species. Data collected from each CREP study site was used to predict the likely presence of specific wildlife species, as predicted by the Illinois GAP Analysis Project databases. Created land-cover images were categorized and compared to the Illinois GAP database for vertebrate species to estimate acreages created. This was potential habitat as no information gained during this study of actual usage of vertebrate species. Species preferring large open areas like the Northern Harrier had the greatest number of created habitat. Wetland species had smaller amounts of habitat created which was broken and disperse with small pockets of habitat. Devault et al. (2002) found recreated grasslands on coalmine sites were valuable for Grasshopper and Henlow's Sparrows, Eastern Meadowlark and Dickcissels. McIntyre and Thompson (2003) found CRP sites supported abundant avian arthropod prey. CRP sites had average bird abundance nearly four times greater than in row-crops (Patterson and Best 2003).

Recreating wetlands is a long and slow process of regeneration whose goals are not quickly seen. CREP is creating critical habitat that is needed by many wetland species. This habitat is slowly developing into suitable wetlands; many bird, mammal, and reptile species were observed while conducting the plant surveys. Natural regeneration is transforming these sites into more diverse wetlands with communities that are more natural.

In Illinois, CREP is restoring wetland acres and providing critical wildlife habitat. More research is needed on the value of restored wetlands, particularly the aspects of size and location relative to other wetlands. If these sites are managed properly with consideration toward site size, hydrology and the control of noxious plant species, they may develop into valuable wetland sites for many listed wetland species and migratory birds that depend on these communities. Managers of Illinois CREP lands should consider site selection in regards to adequate hydrologic source, location near other wetlands, adjoining sites to increase effective area; maintenance of site to control nuisance species; and monitoring site progress.

CREP and land reserve programs have significantly benefited populations of upland nesting ducks (Reynolds 2001). The conversion of cropland into areas of idle grasses that result in secure nesting areas with increased nest success (Reynolds 2001) and are likely both directly and indirectly an enhancement to duck and other species populations. CREP and CRP are creating critical habitat for many of Illinois' wildlife species, including those that are threatened and endangered. Future studies are needed to test the effectiveness of the CREP program, reliability of the wetland assessment methodology used in this study and the application of the GAP database.

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Table 5.13. Frequency of most abundant plant species in Illinois CREP wetland sites signed contractually in 2000.

Table 514. Frequency of most abundant plant species in Illinois CREP wetland sites signed contractually in 1999.

Table 5.15. Frequency of most abundant plant species in Illinois CREP wetland sites signed contractually in 1998.

Figure 4.3 Estimated general habitat distribution for CREP wetland acres for the entire Illinois River basin based on sample data taken in 2003 and then extrapolated to estimate the entire Illinois program.

Appendix 6. Potential Created CREP Acreage for Illinois species.

Table 6.16. Potential acreage benefits to threatened and endangered species created by Illinois CREP. These acres of land provide acceptable habitat for these species--actual use is unknown. Acreage is estimated and is likely somewhat smaller in reality because of specific species requirements not measured in this study.

Table 6.17. Potential acreage benefits to non-threatened and non-endangered species created by CREP. These acres of land provide acceptable habitat for these species--actual use is unknown. Acreage is estimated and is likely somewhat smaller in reality because of specific species requirements not measured in this study.

Appendix 1. Illinois CREP Area and Methods

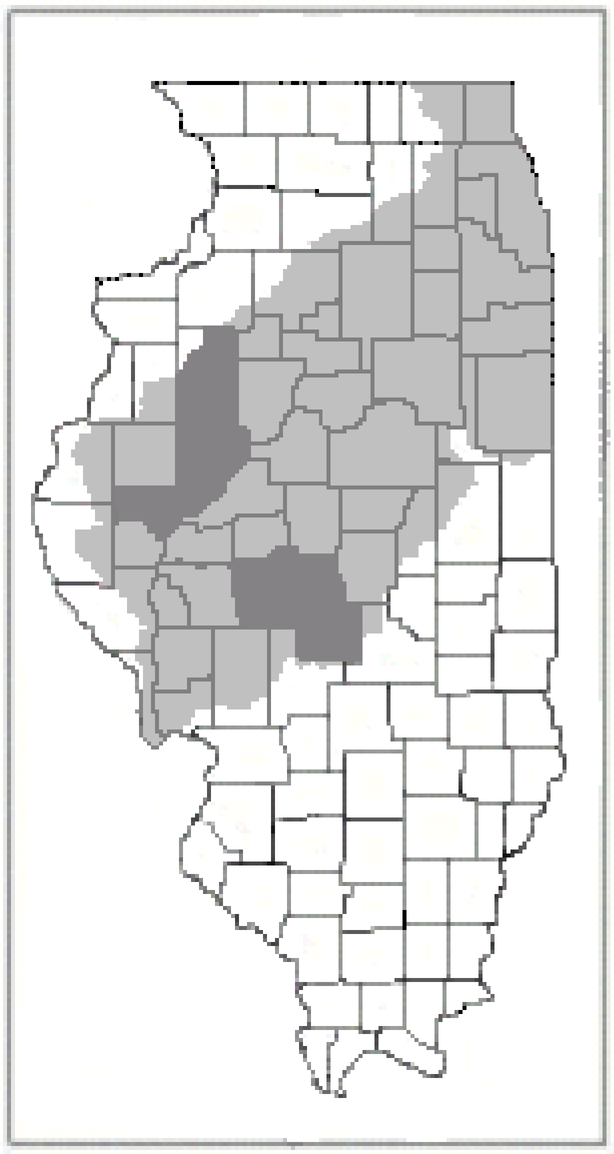

Figure 1.1. Illinois CREP's eligible area (light gray), as found within the Illinois River watershed, with counties sampled (dark gray).

Table 1.1. Foliage Density\Cover Classes for Use in Wetlands (adapted from Daubenmire 1968).

Cover Class	Aerial Coverage
1	1-9%
2	10-40%
3	40-60%
4	60-80%
5	80-100%

Appendix 2. Wildlife-Suitability Scoring Index.

Table 2.2. Wildlife-suitability scoring index main categories. (Balzano et al. 2002)

I.	Hydrology
II.	Soils
III.	Vegetation Composition Shrubs/ Trees
IV.	Vegetation Composition Ground Cover
V.	Wildlife Suitability
VI.	Site Characteristics
VII.	Buffer

Table 2.3. Wildlife-suitability scoring index category relative scores. (Balzano et al. 2002)

Relative Rank	Index Score	Potential to Provide Desirable Wetland Function and Value
I	3	High
II	2	Moderate to Low
III	1	Poor

Table 2.4. Wildlife-suitability scoring index main category-weighting scores, based on importance to quality of habitat from multiply independent scientists. (Balzano et al. 2002)

	Category	Weighting Score
I.	Hydrology	4.8
II.	Soils	3.6
III.	Vegetation Composition Shrubs/ Trees	3.7
IV.	Vegetation Composition Ground Cover	3.7
V.	Wildlife Suitability	2.1
VI.	Site Characteristics	3.0
VII.	Buffer	3.6

Table 2.5. Wildlife-suitability score generalized math procedure. (Balzano et al. 2002)

Weighted value = $\sum$ (category score * weighted score)
Suitability score = weighted value / $\sum$ weighted scores

Table 2.6. Wildlife-suitability scoring index main categories, sub-categories and relative rank descriptions. (Adapted from Balzano et al. 2002)

Scoring Matrix
Hydrology

Wetland Hydrology	Undesirable Plant Colonization	Surface Inundation	Water Flow Channelization	Hydric Soils	Water Presence
adequate	none	abundant	none	good	coverage
inadequate	minimal	moderate	little	minimal	high water marks
lacking	extensive	none	extensive	none	none

Soil

Erosion	Detritus Layer
minimal	well developed
some	minimal
heavy	none

Vegetation Composition Shrub/Trees

Plant Cover	Invasive Species	Natural Recruitment	Diversity
abundant	<1%	strong	high
moderate	1-50%	some	moderate
minimal	>50%	none	minimal

Vegetation Composition Ground Cover

Plant Cover	Invasive Species	Natural Recruitment	Diversity
abundant	<1%	strong	high
moderate	1-50%	some	moderate
minimal	>50%	none	minimal

Wildlife suitability

Cover	Adjacent Resources
abundant	abundant
adequate	adequate
inadequate	inadequate

Site characteristics

Size	Wetland Isolation	Diversity	Slope	Edge
>50 acres	upstream & downstream	good	none	small
10-50 acres	up or down	some	moderate	moderate
<10 acres	none	none	steep	excessive

Buffer

Width	Habitat	Cover	Land Use
>50'	germinate	adequate	undeveloped
10-50'	moderate	limited	agriculture
<10'	annual	none	residential/roadway

Appendix 3. Indiana Hydrophyte Checklist

Table 2.7. Indiana hydrophyte checklist giving conservation values for each species represented. (Squires et al. 2000)

lvs.=leaves Numbers = coefficients of conservatism
* = species with coefficient conservatism of 7 or more

Herbs: non-seed plants
___ horsetail, scouring rushes (*Equisetum* spp.) 2
___*ferns: *Dryopteris* spp. (marsh shield fern) 7
___**Onoclea sensibilis* (sensitive fern) 8
___ **Osmunda* spp. (cinnamon-, royal fern) 8
___*marsh club moss (*Selaginella apoda*) 10
___*Sphagnum mosses (*Sphagnum* spp., N) 10

Herbs: lvs. floating or submergent
___*bladderwort (*Utricularia* spp., N) 10
___ coontail (*Ceratophyllum demersum*, N) 5
___ duckweeds (*Lemnaceae* spp.) 5
___*pondweeds (*Potamogeton* spp.) 8 (except 0 for introduced *P. crispus*)
___*water lily (*Nymphaea tuberosa*, N) 7
___*water shield (*Brasenia schreberi*, N) 10
___*yellow spatterdock (*Nuphar* spp.) 8

Herbs: insectivorous plants
___*pitcher plant (*Sarracenia purpurea*,N) 10
___*sundews (*Drosera* spp., N) 10

Herbs: linear-lvs. or ± leafless monocots
___*beak rush (*Rhynchospora* spp., N) 10
___ blue flag iris (*Iris virginica*) 5
___ bulrushes (*Scirpus* spp.) 5
___*bur reed (*Sparganium* spp., N) 9
___ cat-tails (*Typha* spp.) 1
___*cotton grass (*Eriophorum* spp., N) 10
___ grasses (family *Gramineae*) – indicate types
a.*wild rice (*Zizania aquatica*, N) 10;
b. most native perennial grasses 4: incl. cut-grass, manna-g, Canada bluejoint, foxtail [*Alopecurus*];
c. introduced grasses 0: reed canary grass [*Phalaris*], reed [*Phragmites*], annual grasses such as annual foxtail [*Setaria*] & barnyard grass [*Echinochloa*]
___*needle sedges (*Eleocharis* spp.) 10 except for blunt needle sedge (*E. obtusa*) 3
___ nutsedges (*Cyperus* spp.) 3
___*orchids (family *Orchidaceae*) 10
___*rushes (*Juncus* spp.) 7
___*sedges (*Carex* spp.) sp.1=5 / sp.2=8 / additional spp.=10
___*sweet flag (*Acorus calamus*) 7
___**3-way* sedge (*Dulichium arundinaceum*) 9
___*twig rush (*Cladium mariscoides*, N) 10
___*umbrella sedge (*Fuirena squarrosa*, N) 10
___ wild hyacinth (*Camassia scilloides*) 6
___*yellow-eyed grass (*Xyris torta*, N) 10

Herbs: wide-leafed monocots
___*arrow arum (*Peltandra virginica*, N) 10
___ arrow-head (*Sagittaria* spp.) 4
___*green dragon (*Arisaema dracontium*) 7
___ Jack-in-the-pulpit (*Arisaema triphyllum*) 4
___*pickerel weed (*Pontederia cordata*, N) 10
___*skunk cabbage (*Symplocarpus foetidus*) 8
___*water arum (*Calla palustris*, N) 10
___ water plantain (*Alisma plantago-aquat.*) 4

Herbs (vines):dicots - lvs. opposite/whorled
___ beggar's ticks (*Bidens* spp.) 5
___ blue vervains (*Verbena hastata*) 4
___ boneset (*Eupatorium perfoliatum*) 4
___ bugleweeds (*Lycopus* spp.) 6
___ clearweeds (*Pilea* spp.) 5
___*cross milkwort (*Polygala cruciata*, N) 10
___ cup plant (*Silphium perfoliatum*) 5
___ false nettle (*Boehmeria cylindrica*) 3
___*fen betony (*Pedicularis lanceolata*) 9
___*gentians (*Gentiana. & Gentianopsis*) 9
___ giant ragweed (*Ambrosia trifida*) 0
___ hedge nettles (*Stachys* spp.) 6
___ Indian hemp (*Apocynum cannabinum*) 4
___ Joe-pye weeds (*Eupatorium* spp.) 6
___ loosestrifes (*Lysimachia* spp.) 4
___*meadow beauty (*Rhexia virginica*) 10
___*monkey flowers (*Mimulus* spp.) 7
___ purple loosestrife (*Lythrum salicaria*) 0
___*richweed (*Collinsonia canadensis*) 10
___*St. John's worts (*Hypericum* spp., N) 10
___ sunflowers (*Helianthus* spp.) 3
___*swp. loosestrife (*Decodon verticillatus*, N)8
___ swamp milkweed (*Asclepias incarnata*) 4
___*turtlehead (*Chelone glabra*) 8
___ virgin's bower (*Clematis virginiana*) 4
___*winged loosestrife (*Lythrum alatum*) 7

Herbs (vines): dicots - lvs. alternate or basal and simple

___ Amer. bellflower (*Campanula americana*)3
___*asters: bristly aster (*Aster puniceus*) 8
___*flat-topped aster (*A. umbellatus*) 9
___ other asters (e.g. New Engl.- , panicled-a.) 4
___*black-eyed Susan (*Rudbeckia fulgida*) 8
___*cardinal flower (*Lobelia cardinalis*) 7
___ garlic mustard (*Alliaria petiolata*) 0
___*golden ragwort (*Senecio aureus*) 7
___*goldenrods (*Solidago ohioensis, S. patula, S. riddellii*) 9
___*grass of Parnassus (*Parnassia glauca*) 10
___*Indian plantain (*Cacalia plantaginea*) 10
___ ironweed (*Vernonia* spp.) 4
___ jewelweed, touch-me-not (*Impatiens* spp.) 4
___*lizard's tail (*Saururus cernuus*) 9
___ lobelias (*Lobelia* spp.) 6
___ marsh marigold (*Caltha palustris*) 5
___ moonseed (*Menispermum canadense*) 6
___*rose mallows (*Hibiscus* spp.) 8
___ smartweeds: jumpseed, pinkweed, waterpepper, water-sm., (*Polygonum* spp.) 4
___**P. sagittatum* (arrow-lvd. tearthumb) 10
___ stinging nettle (*Laportea canadensis*) 3
___ swamp-dock, water-, pale- (*Rumex* spp.) 6
___ Virginia bluebells (*Mertensia virginica*) 5
___ wingstem (*Actinomeris alternifolia*) 5

Herbs (vines): dicots - lvs. basal or alternate and compound or deeply lobed

___ avens: rough a.., white a. (*Geum* spp.) 2
___ buttercups: cursed b., hooked b., swamp b. (*Ranunculus* spp.) 5
___ chervil (*Chaerophyllum procumbens*) *5*
___*cowbane (*Oxypolis rigidior*) 7
___*great angelica (*Angelica atropurpurea*) 7
___ hog peanut (*Amphicarpa bracteata*) 4
___ honewort (*Cryptotaenia canadensis*) 2
___ meadow rues (*Thalictrum* spp.) 5
___ poison ivy (*Rhus radicans*) 2
___*queen-of-the-prairie (*Filipendula rubra*) 10
___*sennas (*Cassia* spp.) 9
___*swamp agrimony (*Agrimonia parviflora*) 7
___*swamp thistle (*Cirsium muticum*) 10
___ tall coneflower (*Rudbeckia laciniata*) 5
___*water hemlocks (*Cicuta* spp.) 7
___*water parsnips (*Sium suave*) 7

Shrubs - leaves opposite or whorled

___*bladdernut (*Staphylea trifolia*) 7
___ buckthorn (*Rhamnus frangula*) 0
___ buttonbush (*Cephalanthus occidentalis*) 5
___ dogwood, rough (*Cornus drummondii*) 2
___ dogwood, blue-fruited or silky (*Cornus obliqua*) 6
___ dogwood, red-osier (*Cornus stolonifera*) 6
___ elderberries (*Sambucus* spp.) 1

Shrubs - lvs. alternate

___*cranberries (*Vaccinium* spp., N) 10
___*dwarf birch (*Betula pumila*, N) 10
___*highbush blueberry (*V. corymbosum*, N) 8
___*leatherleaf (*Chamaedaphne calycul.*, N) 10
___*meadowsweet & hardhack (*Spiraea* spp.) 8
___*ninebark (*Physocarpus opulifoius*) 8
___*shrubby cinquefoil (*Potentilla fruticosa*) 10
___*spice bush (*Lindera benzoin*) 7
___*swamp rose (*Rosa palustris*) 7
___*winterberry (*Ilex verticillata*) 9

Trees - lvs. needle shaped

___*tamarack (*Larix laricina*, N) 10

Trees - lvs. compound

___ ashes, white a., green a. (*Fraxinus* spp.) 5
___*ash, black (*Fraxinus nigra*) 10
___*ash, pumpkin (*Fraxinus tomentosa*, SW) 10
___ boxelder (*Acer negundo*) 0
___ honey locust (*Gleditsia triacanthos*) 2
___*kingnut hickory (*Carya laciniosa*) 10
___*poison sumac (*Rhus vernix*) 10

Trees - lvs. simple and opposite

___*red maple (*Acer rubrum*) 7
___ silver maple (*A. saccharinum*) 0

Trees - lvs. simple and alternate

___ American sycamore (*Platanus occident.*) 9
___*black gum (*Nyssa sylvatica*) 8
___ cottonwood, eastern (*Populus deltoides*) 2
___*cottonwood, swamp (*P. heterophyl.*, SW) 10
___ elms (*Ulmus* spp.) 3
___ hackberry (*Celtis occidentalis*) 3
___*ironwood (*Carpinus caroliniana*) 8
___ oaks: white (*Quercus alba*) 5
___ swamp white o. (*Q. bicolor*) 6
___*pin oak (*Q. palustris*) 8
___*papaw (*Asimina triloba*) 9
___*river birch (*Betula nigra*) 7
___ white mulberry (*Morus alba*) 0
___ willows (*Salix* spp.) 5

OTHER ________________________________

Appendix 4. Main Results.

Table 4.8. CREP wetland acres of sample sites in Illinois given contract year.

Contract Year	Number of sites	Average	Minimum	Maximum
1998	14	10.11	3.10	37.60
1999	14	20.20	2.10	100.00
2000	34	35.36	1.70	118.50
2001	19	42.03	2.30	120.00
2002	11	13.81	4.00	58.00
Total	92	28.35	1.70	120.00

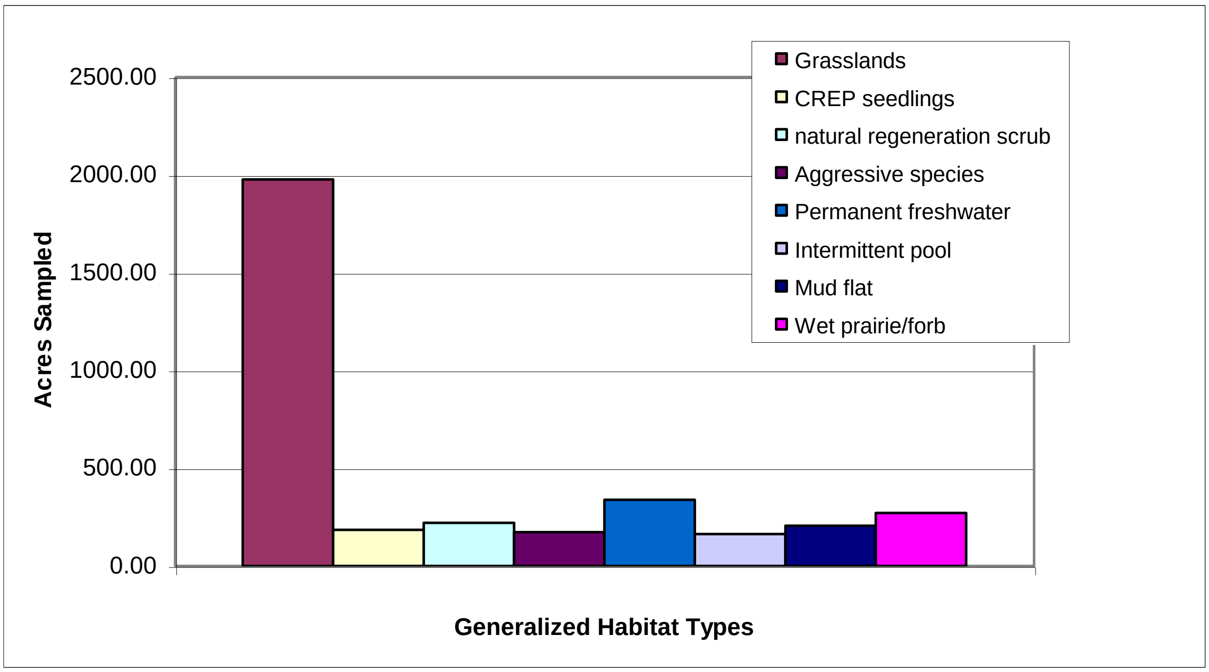

Figure 4.2. CREP acres sampled during the 2003 sample period within the Illinois River watershed, categorized by their general habitat.

Table 4.9. Wildlife-suitability index components (non-weighted) scores for CREP wetland sites in Illinois during the 2003 sampling season.

Habitat categories	Minimum	Maximum	Average
Hydrology	1.17	2.83	1.94
Soil	1.00	2.00	1.58
Vegetation (Shrub\Tree)	1.00	2.75	2.16
Vegetation (Ground Layer)	1.25	2.75	2.20
Wildlife Suitability	0.91	2.73	2.16
Site Characteristics	1.00	2.80	2.19
Buffer Area	1.00	2.75	2.11

Table 4.10. Wildlife-suitability scoring totals for Illinois CREP wetland sites arranged by contract year.

Contract Year	Minimum	Maximum	Average	95% Confidence
Total all sites	1.26	2.16	1.71	1.73 + 0.08
1998	1.30	1.95	1.62	1.63 + 0.25
1999	1.50	1.95	1.67	1.72 + 0.17
2000	1.26	2.16	1.78	1.78 + 0.11
2001	1.34	2.07	1.71	1.72 + 0.19
2002	1.34	1.83	1.60	1.57 + 0.21

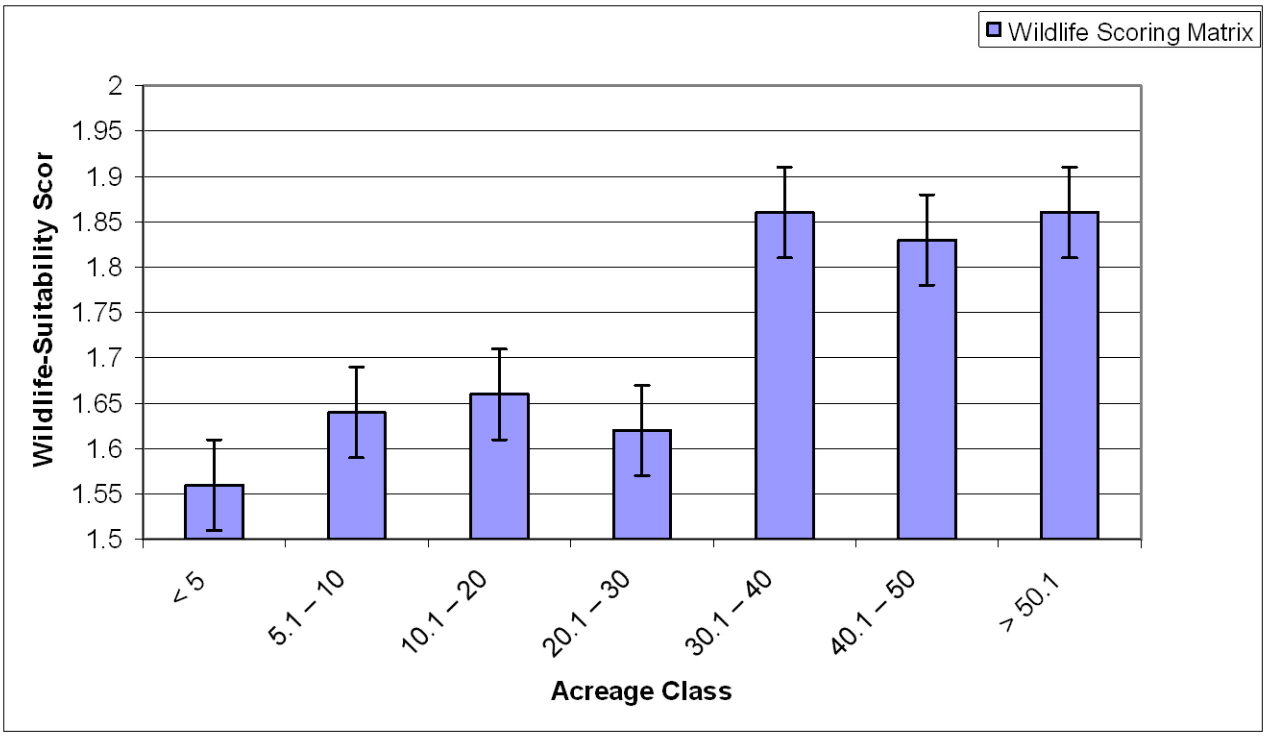

Figure 4.4. Wildlife-suitability scores for Illinois CREP sites sampled in 2003, ordered by acreage showing the 5 percent error.

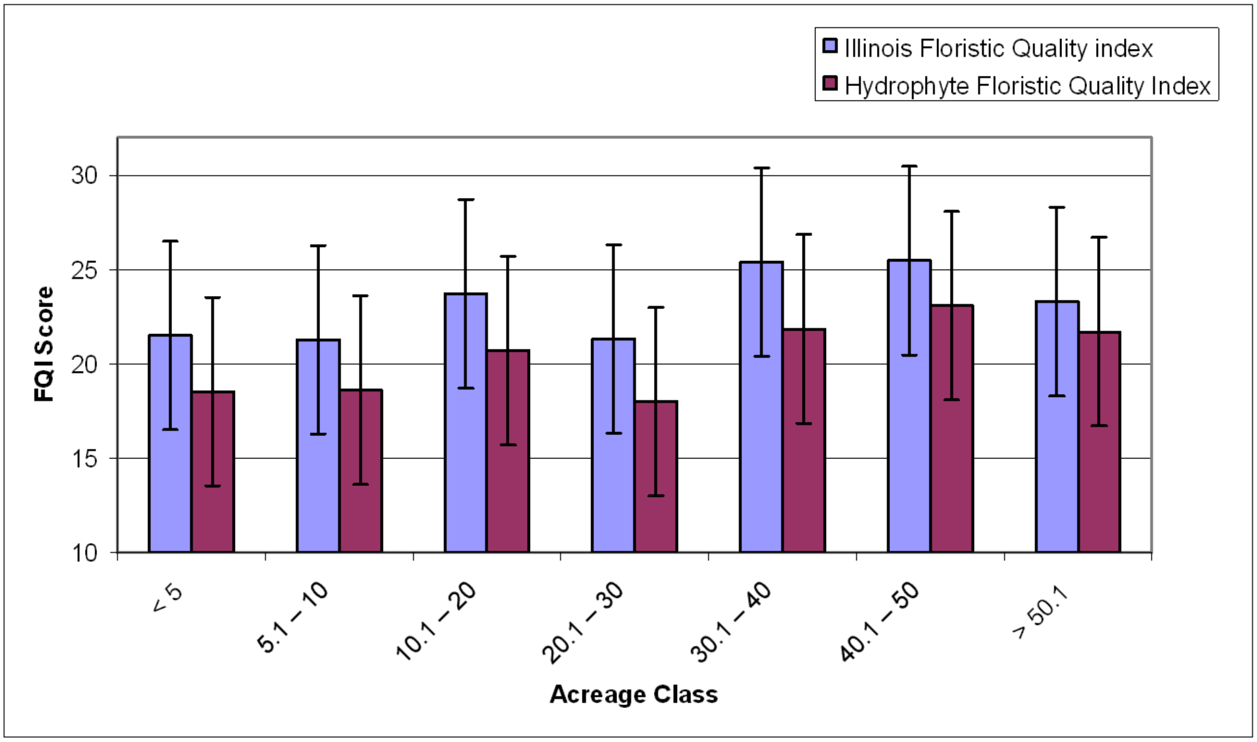

Figure 4.5. FQI for Illinois CREP sites sampled in 2003, ordered by acreage showing 5 percent error.

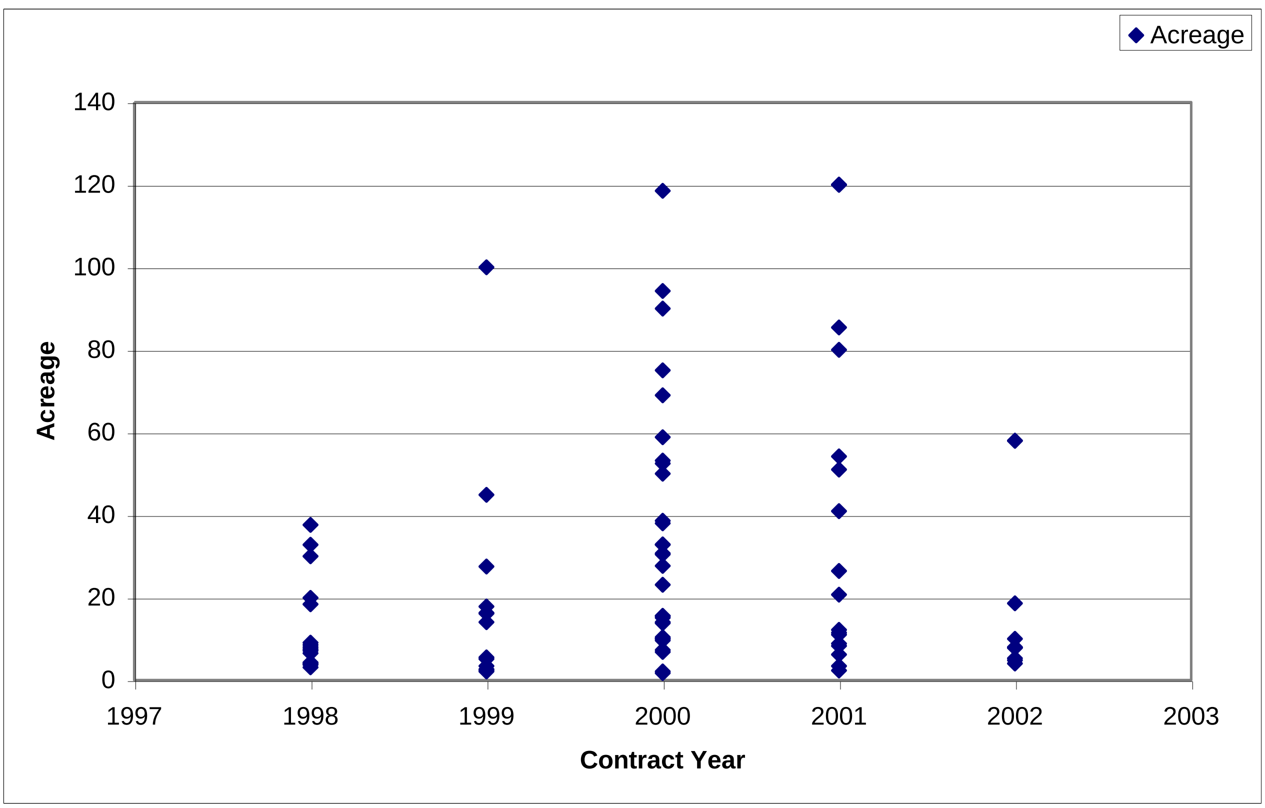

Figure 4.6. Comparison of acreage and contract year for CREP sites sampled in 2003.

Appendix 5. Aerial coverage of plants species.

Table 5.11. Frequency of most abundant plant species in Illinois CREP wetland sites signed contractually in 2002.

Species	# sites found in	Times found in samples	Mean Aerial Coverage	Total Aerial Coverage (m2)
Setaria spp	10	19	42	807
Xanthium strumarium	8	12	25	304
Polygonum spp	7	19	27	515
Carex spp	7	13	37	479
Eleocharis tenuis	5	12	38	461
Ambrosia trifida	5	8	28	220
Acer saccharinum	4	5	12	59
Phalaris spp	3	9	66	595

Table 5.12. Frequency of most abundant plant species in Illinois CREP wetland sites signed contractually in 2001.

Species	# sites found in	Times found in samples	Mean Aerial Coverage	Total Aerial Coverage (m2)
Carex spp	6	17	34	577
Polygonum spp	6	17	41	691
Acer saccharinum	6	10	6	60
Ambrosia trifida	5	11	19	214
Setaria spp	4	9	35	317
Phalaris spp	4	8	61	486
Andropogon gerardii	4	7	49	343
Echinochloa	4	4	19	75
Populus deltoids	3	7	5	35
Xanthium strumarium	3	6	20	120

Table 5.13. Frequency of most abundant plant species in Illinois CREP wetland sites signed contractually in 2000.

Species	# sites found in	Times found in samples	Mean Aerial Coverage	Total Aerial Coverage (m2)
Setaria spp	13	45	42	1883
Polygonum spp	12	32	50	1595
Ambrosia trifida	11	25	62	1551
Echinochloa	9	21	50	1050
Salix nigra	7	17	24	411
Eleocharis tenuis	6	11	43	471
Andropogon gerardii	5	13	51	661
Carex spp	5	9	29	257
Xanthium strumarium	5	6	22	133
Phalaris spp	5	8	85	680

Table 5.14. Frequency of most abundant plant species in Illinois CREP wetland sites signed contractually in 1999.

Species	# sites found in	Times found in samples	Mean Aerial Coverage	Total Aerial Coverage (m2)
Ambrosia trifida	9	18	39	693
Solidago spp	7	9	23	205
Bromus kalmii	5	5	49	244
Acer saccharinum	4	8	37	297
Polygonum spp	4	10	22	217
Carex spp	4	8	35	279
Phalaris spp	2	9	88	790

Table 5.15. Frequency of most abundant plant species in Illinois CREP wetland sites signed contractually in 1998.

Species	# sites found in	Times found in samples	Mean Aerial Coverage	Total Aerial coverage (m2)
Phalaris spp	12	31	88	2725
Polygonum spp	10	24	44	1047
Carex spp	5	15	26	393
Acer saccharinum	7	22	44	975
Ambrosia trifida	5	9	14	127
Populus deltoids	5	9	28	248
Bromus kalmii	3	4	40	160
Salix nigra	4	8	52	413
Setaria spp	2	3		

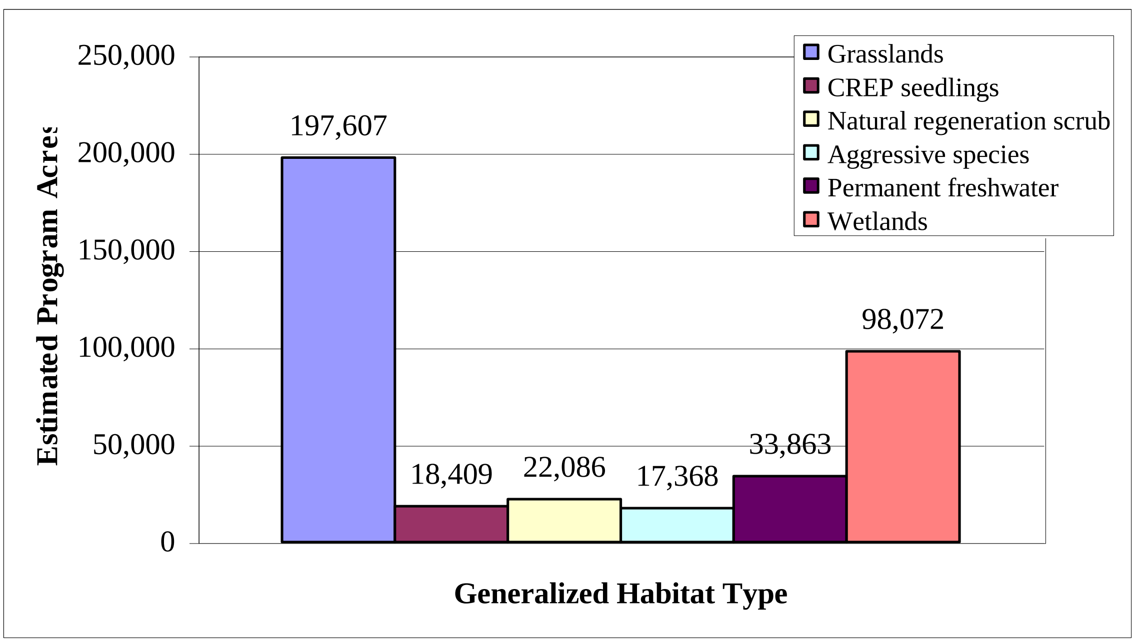

Figure 4.3. Estimated general habitat distribution for CREP wetland acres for the entire Illinois River basin based on sample data taken in 2003 and then extrapolated to estimate the entire Illinois program.

Appendix 6. Potential Created CREP Acreage for Illinois species.

Table 6.16. Potential acreage benefits to threatened and endangered species created by Illinois CREP. These acres of land provide acceptable habitat for these species--actual use is unknown. Acreage is estimated and is likely somewhat smaller in reality because of specific species requirements not measured in this study.

Species Name	Status	Potential Habitat Created (Acres)		Habitat Type
		Sampled CREP	Illinois CREP Total (Extrapolation of 2003 data)	
American bittern (*Botaurus lentiginosus*)	E	164	16,375	breeding
Bald eagle (*Haliaeetus leucocephalus*)	E	160	15,998	winter
Black-crowned night heron (*Nycticorax nycticorax*)	E	213	21,253	breeding
Least bittern (*Ixobrychus exilis*)	E	219	21,858	breeding
Northern harrier (*Circus cyaneus*)	E	2639	263,854	wintering\forage
Upland sandpiper (*Bartramia longicauda*)	E	1976	197,610	breeding
Brown creeper (*Certhia americana*)	T	0	0	winter
Double-crested cormorant (*Phalacrocorax auritus*)	T	160	15,998	migratory
Great egret (*Casmerodius albus*)	T	20	2000	breeding
King rail (*Rallus elegans*)	T	478	47,835	breeding
Loggerhead shrike (*Lanius ludovicianus*)	T	1976	197,610	breeding
Pied-billed grebe (*Podilymbus podiceps*)	T	642	64,210	year-around
Indiana Bat (*Myotis sodalis*)	E	147	14,698	forage habitat
Bobcat (*Lynx rufus*)	T	18	1800	habitat
Eastern massasauga (*Srurus catenatus*)	E	98	9778	year-around
Kirtland's snake (*Clonophis kirtlandi*)	T	85	85,256	year-around
Four-toed salamander (*Hemidactylium scutatum*)	T	142	800	year-around
Streckers Chorus Frog (*Pseudacris streckeri*)	T	0	500	year-around

Table 6.17. Potential acreage benefits to non-threatened and non-endangered species created by CREP. These acres of land provide acceptable habitat for these species--actual use is unknown. Acreage is estimated and is likely somewhat smaller in reality because of specific species requirements not measured in this study.

Species Name	Status	Potential Habitat Created (Acres)		Habitat Type
		Sampled CREP	Illinois CREP Total (Extrapolation of 2003 data)	
American Goldfinch (*Carduelis tristis*)		2433	243,214	year-around
American White Pelican (*Pelecanus erythrorhynchos*)		339	33,864	migration
American Wigeon (*Anas americana*)		981	98,074	wintering
American Woodcock (*Scolopax minor*)		405	40,496	breeding
Barn Owl (*Tyto alba*)		0	0	year-around
Belted Kingfisher (*Ceryle alcyon*)		little to none	little to none	year-around
Blue-winged Tea (*Anas discors*)		502	50,239	breeding
Bobolink (*Dolichonyx oryzivorus*)		1976	197,610	breeding
Canada Goose (*Branta canadensis*)		981	98,074	breeding/wintering
Canvasback (*Aytha valisineria*)		<100	9999	wintering
Clay-colored Sparrow (*Spizella pallida*)		2381	238,106	migration
Common Yellowthroat (*Geothlypis trichas*)		221	22,086	breeding
Dickcissel (*Spiza americana*)		1976	197,610	breeding
Eastern Bluebird (*Sialia sialis*)		2183	218,250	breeding
Eastern Meadowlark (*Sturnella magna*)		1704	170,416	year-around
Field Sparrow (*Spizella pusilla*)		1976	197,610	year-around
Gadwall (*Anas strepera*)		339	33,864	wintering
Grasshopper Sparrow (*Ammodramus savannarum*)		1976	197,610	breeding
Great Blue Heron (*Ardea herodias*)		160	15,998	year-around
Great Horned Owl (*Bubo virginianus*)		2531	253,035	year-around
Green Heron (*Butorides virescens*)		799	79,860	breeding
Green-winged Teal (*Anas crecca*)		164	16,375	migration
Horned Lark (*Eremophila alpestris*)		750	74,988	year-around
Indigo Bunting (*Passerina cyanea*)		1889	188,825	breeding
Killdeer				

(*Charadrius vociferous*)	2619	261,821	breeding
Lark Sparrow			
(*Chondestes grammacus*)	2161	216, 020	breeding
Least Sandpiper			
(*Calidris minutilla*)	478	47,835	migration
Mallard			
(*Anas platyrhynchos*)	506	50,631	breeding/wintering
Marsh Wren			
(*Cistothorus palustris*)	478	47,835	breeding
Northern Pintail			
(*Anas acuta*)	339	33,864	migration
Northern Shoveler			
(*Anas clypeata*)	339	33,864	migration
Pectoral Sandpiper			
(*Calidris melanotos*)	642	64,210	migration
Red-shouldered Hawk			
(*Buteo lineatus*)	0	0	year-around
Savannah Sparrow			
(*Passerculus sandwichensis*)	1976	197,610	migration
Sedge Wren			
(*Cistothorus platensis*)	642	64,210	breeding
Short-billed Dowitcher			
(*Limnodromus griseus*)	0	0	migration
Short-eared Owl			
(*Asio flammeus*)	0	0	non-breeding
Snow Goose			
(*Chen caerulescens*)	981	98,074	migration
Solitary Sandpiper			
(*Tringa solitaria*)	642	64,210	migration
Song Sparrow			
(*Melospiza melodia*)	405	40,956	breeding/wintering
Sora			
(*Porzana Carolina*)	642	64,210	migration
Spotted Sandpiper			
(*Actitis macularia*)	175	17,497	breeding
Swamp Sparrow			
(*Melospiza georgiana*)	642	64,210	wintering
Tundra Swan			
(*Cygnus columbianus*)	160	15,998	migration
Vesper Sparrow			
(*Pooecetes gramineus*)	1704	170,416	breeding
Western Meadowlark			
(*Sturnella neglecta*)	1976	197,610	non-breeding
Willet			
(*Catoptrophorus semipalmatus*)	781	78,077	migration
Wood Duck			
(*Aix sponsa*)	502	50,239	year-around